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AMENDMENT No. 1 TO THE NASA RESEARCH ANNOUNCEMENT (NRA) ENTITLED "RESEARCH OPPORTUNITIES IN AERONAUTICS – 2009 (ROA-2009)," NNH09ZEA001N-1, RELEASED July XX, 2009

The following changes are made to:

- Updated Table of Contents
- Summary of Solicitation: Table 2
- Summary of Solicitation: Table 3
- Appendix A-2

Summary of Solicitation Table 2 and Table 3 are updated

New proposal and NOI due dates in place for the Topics Appendix A-2.

TABLE 2. SOLICITED RESEARCH PROGRAMS (IN ORDER OF PROPOSAL DUE DATES)

APPENDIX	PROGRAM	NOI DUE DATE	PROPOSAL DUE DATE
A-2	Subsonic Fixed Wing – "N+2 Advanced Low NOx Combustor Technologies" (SSFW1)	TBD	TBD

Note: It is expected that additional project areas will be added in future amendments.

TABLE 3. SOLICITED RESEARCH PROGRAMS (IN ORDER OF APPENDICES A–D)

APPENDIX	PROGRAM	NOI DUE DATE	PROPOSAL DUE DATE
A-2	Subsonic Fixed Wing – "N+2 Advanced Low NOx Combustor Technologies" (SSFW1)	TBD	TBD

Note: It is expected that additional project areas will be added in future amendments.

Appendices A-2

A-2: Subsonic Fixed Wing

1. Project Overview

A major focus of the Subsonic Fixed Wing (SFW) project is to develop improved prediction methods and technologies for lower noise, lower emissions, and higher performance for subsonic aircraft. Increased performance requires increased energy efficiency and operability for advanced airframe and engine systems and subsystems. The ten-year strategy includes providing novel test methods and validated prediction tools that can be used to improve system trades for advanced concepts that are capable of meeting long-term noise, emissions, and performance targets.

Table 1 summarizes the SFW Project's vehicle technology goals for future generation aircraft, each of which represents a "corner" of the trade space. It is desirable to identify vehicle solutions that simultaneously meet the goals for noise, emissions, and energy usage (fuel burn).

Table 1 – NASA's Technology Goals for Future Subsonic Vehicles

CORNERS OF THE TRADE SPACE	N+1 (2015)*** Generation Conventional Configurations relative to 1998 Single Aisle	N+2 (2020)*** Generation Unconventional Configurations relative to 1997 Large Twin Aisle	N+3 (2025)*** Generation Advanced Aircraft Concepts relative to user defined reference
Noise	- 32 dB (cum below Stage 4)	- 42 dB (cum below Stage 4)	- 71 dB (cum below Stage 4)
LTO NOx Emissions (below CAEP 6)	-60%	-75%	better than -75%
Performance: Aircraft Fuel Burn	-33%**	-40%**	better than -70%
Performance: Field Length	-33%	-50%	exploit metro-plex* concepts

*** Technology Readiness Level Range = 4-6

** An additional reduction of 10 percent may be possible through improved operational capability

* Concepts that enable optimal use of runways at multiple airports within the metropolitan areas

2. Description of Solicited Research

NASA goals are to expand the viable and well-informed trade space for vehicle design decisions and enable simultaneous realization of National noise, emissions, and performance goals. In this solicitation, NASA is seeking proposals that will identify new combustor concepts capable of meeting N+2 NOx goals, conduct initial screening experiments, develop technologies and roadmaps, construct a test rig capable of testing advanced combustors at realistic advanced engine conditions, and conduct testing at and with NASA. These efforts are expected to be 18-20 months in duration, approximately 50/50 (cash and in-kind) cost share is desired, and two awards are anticipated. A total of $14M of the American Recovery and Reinvestment Act (ARRA) funding investment is anticipated.

2.1 Subsonic Fixed Wing N+2 Advanced Low NOx Combustor Technologies

2.1.1 Objective

Develop a low emissions combustor capable of meeting the LTO (landing and take-off) NOx emissions reduction goal and help make the fuel burned goal without negatively impacting other emissions.

2.1.2 Approach

Develop a combustion concept using computational combustion codes to identify the most promising fuel injector concepts and enabling barrier technologies needed. The low emissions combustor must be capable of meeting the N+2 LTO NOx goal of 75% reduction from the ICAO (International Civil Aviation Organization) standard adopted at CAEP (Committee on Aviation Environmental Protection) 6.

A Preliminary Design Review will be conducted for the thermal and mechanical details of a single-injector flametube or three-injector sector test section designed to operate at realistic engine conditions (conditions based on the contractor's advanced engine capable of meeting the N+2 NASA noise, emissions, and performance goals). The Preliminary Design and contractor's advanced engine cycle must be approved by NASA, prior to the start of any major hardware fabrication or technology development. After the Preliminary Design is approved, the initial screening tests of the combustion concept will be conducted at the Contractor’s facility to:

- Optimize the fuel injector/mixer performance,
- Evaluate the enabling technologies (i.e., active combustion control, combustor liner material), and
- Assess the fuel flexibility and adaptability.

Upon completion of the initial screening tests, a single-injector flametube or three-injector sector will be built-up or refurbished as needed, with a complete instrumentation package for emission testing at realistic engine conditions, using NASA Glenn’s Advanced Subsonic Combustion Rig (ASCR) facility. The Contractor will provide full emissions testing support of the testing at NASA and will assess the combustor emissions and performance data provided by NASA personnel.

The low emissions combustor design, emissions and performance data, fuel flexibility/adaptability assessment(s), and the enabling technologies test results will be presented to NASA as deliverables. It is NASA's intent to share knowledge developed under this solicitation with the U.S. Aerospace Community at the conclusion of this work.

2.1.3 Relevant SFW Milestones

SFW.4.01.03A - Development and Assessment of Advanced Concepts

2.1.4 Outcome

The required outcome of the low emissions combustor design and testing:

- Meeting the stringent LTO NOx goal of 75% reduction from CAEP 6 with at least 5% margin during initial single-injector flametube or three-injector sector testing,
- Meeting the stringent LTO NOx emissions goal of 75% reduction from CAEP 6 during single-injector flametube or three-injector sector at realistic N+2 engine conditions,
- Exhibiting a comparable cruise NOx reduction,
- Showing no increase of carbon monoxide, unburned hydrocarbons or smoke and particulates,
- Demonstrating fuel flexibility, good operability, combustion stability over the complete operating range, and durability,
- Documentation of the low emissions combustor design and emissions and performance data and the enabling barrier technologies.

3. Programmatic Considerations

Approximately $14M (split between 2 awards) is anticipated and approximately 50/50 (cash and in-kind) cost share is desired. In-kind cost share may include existing research combustor components, instrumentation, and/or rig hardware. The actual number and value of the awards will depend on the quality of the proposals received.

The technical section of the proposal is the most important for selection. It must clearly describe:

- Statement of relevance to the Subsonic Fixed Wing (SFW) project specified objectives of this solicitation.
- Background and objectives of the proposed research.
- Approaches to be considered.
- Scalability and traceability of the validation concept(s) being considered to the full-scale "N+2" vehicle class.
- Level of effort to be employed.
- Schedule with milestones and specific quantifiable metrics to be used to judge progress toward achieving the proposed goal.
- Work plan including a comprehensive Statement of Work.
- Cost sharing (cash and in-kind) details
- Anticipated results and deliverables at the end of the study.
- Description of the qualifications, capabilities, and experience of the team members in the activities related to the content proposed in the work plan.

- Statement of what intellectual property is expected to be publicly available to the U.S. Aerospace Community at the conclusion of the work (note that it is our intent to share knowledge developed under this solicitation, thus, any restrictions to that objective may impact the evaluation of the proposal).
- Schedule for oral presentations (mid-term and final), interim quarterly reports, and final report. A travel budget to support proposed reviews and other interactions should be included in the proposal.

The science-technical-management section must not exceed 20 pages. Supporting information such as budget, resumes, and commitment letters will not be counted toward the 20 page limit. Please refer to section IV of this solicitation, "Proposal and Submission Information", for requirements on proposal content, format, budget details, and submission procedures. Bidders should propose an appropriate level of effort (cost and duration). The estimated level of effort provided with the topic description is for general guidance.

There will be a kick-off meeting at the beginning of the award period, 6-month, 12-month, and final reviews to monitor progress. Final oral presentations to be made as part of an open technical exchange meeting for purposes of technology transfer and knowledge dissemination will be expected. These meetings will be held at one of the NASA centers, and must be attended by at least the principal investigator for the award. Quarterly progress reports are expected; the information in these reports will be one of the factors used to determine whether adequate progress has been made. Complete documentation of approach and results in the form of a written final report is required at the end of the complete effort. The final report will be published as a NASA CR (Contractor Report) on the propulsion, airframe or vehicle system-level tests.

The intent of the NRA process is to foster strategic partnerships between NASA and the awarded institutions for collaborative research and development of innovative concepts, ideas, technologies and approaches. Therefore substantial interaction with NASA researchers may be anticipated while performing work under these awards. Bidders may include as part of the proposal, visits of appropriate length to a NASA Center for the purpose of coordinating the proposed work with corresponding efforts by NASA researchers.

The following information is requested to supplement the information requested in NRA Section IV(b)(III) "Additional ROA Requirements for Budget Formats":

- Cost proposals should provide sufficient detail to allow direct and indirect rate verifications with DCAA and audit of selected costs, if necessary. It is expected that adequate price competition will be obtained and that a determination of price reasonableness will be made in accordance with FAR 15.403-3.
- Offerors should include information other than cost of pricing data (see FAR 15.403-3). Cost of pricing information will not be requested unless proposed prices appear unreasonable or unrealistically low given the offeror's proposed approach and concerns that the offeror may not be able to accomplish the effort within the proposed cost. Offerors will be advised if cost or pricing data is needed (See FAR 15.403-4).

4. American Recovery and Reinvestment Act (ARRA) Reporting Requirements

Contractors who receive Recovery Act funds are required to report on the use of the funds quarterly, using the tool at www.FederalReporting.gov to report first-tier subcontracts, executive compensation, and jobs created or retained, work progress, and amount invoiced, etc. The Federal Reporting website is publically available and the information reported by the Federal contractors will serve to provide transparent information on the use and effectiveness of Recovery Act funds.

5. Evaluation Criteria and Basis for Award

The evaluation criteria in Appendix B, part (i) and Appendix C, paragraph C.2 of the "Guidebook for Proposers Responding to a NASA Research Announcement - 2009" are superseded by the following. Every proposal will be evaluated on its own merits and not compared with other proposals. The principal elements considered in evaluating a proposal are its relevance to NASA's objectives, technical merit, effectiveness of the proposed work plan (including cost), and proposed team qualifications. Failure of a proposal to be highly rated in any one of the following elements is sufficient cause for the proposal to not be selected.

1. Relevance (weight 20%):
- Evaluation of a proposal's relevance to NASA's objectives includes the consideration of the potential contribution of the effort to the specific objectives and goals given in the solicitation to which the proposal is submitted.
- The evaluation process will also consider the importance of the work to the primary project objectives of advancing knowledge and understanding of the fundamental principles of flight unique to subsonic flight.

2. Technical Merit (weight 35%):
- Overall scientific or technical merit of the proposal, including unique and innovative methods, approaches, or concepts.
- Evaluation will also include: credibility of technical approach, including a clear assessment of primary risks and a means to address them; proposer's capabilities, related experience, facilities, techniques, or unique combination of these which are integral factors for achieving the proposal's objective.
- The selection process will also assess the proposal against the state-of-the-art.

3. Effectiveness of the Proposed Work Plan (weight, 20%):
- Comprehensiveness of work plan, cost sharing (cash and in-kind), effective use of resources, cost, management approach, and proposed schedule for meeting the objectives.
- Objectives with measurable metrics toward achieving the proposer's goal must be provided, with a minimum of one metric per year.
- Documentation of approach and results in the form of final written technical reports is required.
- A clear statement of what intellectual property is expected to be publicly available to the U.S. Aerospace Community at the conclusion of the work. It is NASA's intent that all deliverables under the contract be provided to NASA with unrestricted/unlimited rights; thus, any restrictions must demonstrate a significant net benefit to NASA and may cause a lower score.
- Collaboration with NASA researchers (including joint use of facilities, sharing of materials, development of computer code modules compatible with NASA's software, and synergistic

research goals) is desirable, with the objective of enhancing knowledge transfer and the long-term value of the proposed work.

4. Proposed Team Qualifications (weight 25%):

- Experience and breadth of the team that is organized to conduct the study.
- Experience of members of the proposer team in subsonic commercial aircraft design.
- Ability of the team to offer innovative approaches to address the aviation design requirements of the future.

6. Summary of Key Information

Expected program budget for new awards	$14M , 50/50 cost share is desired
Number of new awards pending adequate proposals of merit	2 awards
Maximum duration of awards	18-20 months
Due date for Notice of Intent to propose (NOI)	See Tables 2 and 3 in the *Summary of Solicitation* of this NRA and Section 2 above.
Due date for proposals	See Tables 2 and 3 in the *Summary of Solicitation* of this NRA and Section 2 above.
NASA objective(s) which proposals must state and demonstrate relevance to	Every proposal must address the specified objectives and outcomes in the solicitation of this NRA.
General information and overview of this solicitation	See the *Summary of Solicitation* of this NRA.
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers Responding to a NASA Research Announcement – 2009* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Page limit for the central Science-Technical-Management section of proposal	20 pages; see also Chapter 2 of the Guidebook for Proposers – 2009.
Submission medium	Electronic proposal submission is required; no hard copy is required. See also Section IV in the Summary of Solicitation of this NRA and Chapter 3 of the NASA *Guidebook for Proposers - 2009*.
Web site for submission of proposal via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Expected award type	Contracts or Cooperative Agreements
Funding opportunity number for downloading an application package from Grants.gov	NNH09ZEA001N-1-SSFW
NASA points of contact (POC)	Email questions to: Subsonicfixedwing@grc.nasa.gov Written responses will be posted on the solicitation website. Principal Investigator (Acting): Ruben Delrosario Project Scientist: Rich Wahls NRA Manager: Kim Pham Procurement POC: Melissa Merrill, melissa.a.merrill@nasa.gov